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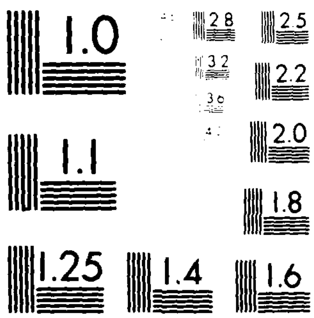

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RASTER SCANNER	SKELETON
RASTER EDIT	FRAME
LASER PLOTTER	PLACE

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Sci-Tex Response 250 Mapping System has been in production at the Defense Mapping Agency Hydrographic/Topographic Center(DMAHTC) for the past two years. Initially acquired for foreign chart modification and color separation, this cartographic system has had a significant impact in rapid response situations. Recent gains in slope generation have further enhanced the capabilities of this automated tool.

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GENERATION

AUTOMATED SLOPE USING
RASTER TECHNOLOGY

MICHAEL P. LEE

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INTRODUCTION

The Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC) is responsible for providing military mapping, hydrographic charting and geodetic support to the Department of Defense. Included in this responsibility is the modification and subsequent reproduction of foreign charts in accordance with exchange agreements between DMAHTC and other chart producing countries. A Sci-Tex Response 250 Mapping System (R250MS) was acquired by DMAHTC in January 1979 to streamline this process in terms of time and materials expended. This color raster system has proven to be a valuable asset to the program as well as vital to many rapid response situations. The major thrust of this paper,however, is to discuss another capability of the Sci-Tex; one of producing slope information in a plate ready form.

THE SCI-TEX RESPONSE 250 MAPPING SYSTEM

The Sci-Tex R250MS is an automated raster scanning system initially developed for the textile industry and recently adapted for the cartographic community. The system as purchased by DMAHTC consists of a color raster scanner (input), two interactive edit stations, and a laser plotter (output). The scanner records up to 12 colors from a source and stores this information in a raster format. The data are then displayed at the edit station for cleaning, enhancement, or other general manipulation. Once in the desired form, it is output by the laser plotter onto photographic film.

The Sci-Tex R250MS Scanner converts source documents (printed maps or charts, color separates, manuscripts) into raster data. In preparing for a scan, the operator mounts the source document on the scanner drum and directs the scanner head to each of the map's colors for calibration. The scanner then automatically recognizes these colors wherever they appear on the map. As the drum revolves, the scanner head senses and records the changes of color along each scan line. The scanner can encode with a selectable resolution of between 4-47 lines per millimeter, though 20 lines per millimeter is a good balance between acceptable line quality and processing time. (As resolution increases, so does the processing time required during the manipulative stages.)

The edit station consists of a 19-inch color console, an electronic stylus, a special function box, an alphanumeric terminal, and a teletype. The color console allows the operator to either display the entire map on the screen, or magnify any portion of it for detailed editing. The stylus, or cursor, acts in a digitizing fashion,changing pixels of one color value to any of the remaining eleven. It is interfaced with the color console, providing the operator with a simultaneous view of the edit. The stylus is also used for referencing locations and other special edit functions.

The function box is used for specific interactive commands while the alphanumeric terminal is for more general dialogue commands. The teletype provides hard copy documentation of dialogue commands.

The laser plotter exposes selected color channels on high contrast, medium speed film. Film is mounted on a high speed drum and exposed with an argon laser beam. Exposure directly from the digital data produces a registered reproducible quality positive or negative in a single pass. Screening options are also available to the operator during the plotting stage. A major advantage of the R250MS laser plotter is its ability to produce a variety of color separates without use of intermediate masks and contact screens.

SLOPE

Traditionally, slope maps have been compiled manually by measuring the distance between contours on a standard topographic map and assigning a slope value according to the scale of the source. Now, with the help of the Sci-Tex R250MS, quick and accurate slope information can be readily obtained.

An automated process to determine slope has recently been under study at DMAHTC. It is based on a photomechanical technique first advanced by Clarence R. Gilman of the U. S. Geological Survey. The underlying concept of this procedure is to spread contour lines into adjacent contours with a series of controlled overexposures of contour negatives. Contours which converge represent areas of an equal slope range.

Percentage of slope is determined by rise over run (RISE/RUN = % SLOPE). For example, a RISE of 20 meters over a distance (RUN) of 20 meters, produces a 100% slope (20/20 = 1.0 or

100%). A RISE of 20 meters with a RUN of 40 meters is a 50% slope (20/40 = .5 or 50%). Therefore, to find the run necessary to achieve a 10% slope with a 20 meter rise, divide 20 by .1, or 200 meters. These derived run values, based on the user's desired slope percentages, must be scaled according to the source. At a scale of 1:50,000 the 200 meter run mentioned above would be .004 meters, or 4 mm.

To use these scaled run values with the R250MS, the resolution of the initial scan must be considered. Scanning contours at a resolution of 20 (20 RES) would produce a scan with pixels(data pts.) .05mm square. Converting source distances to pixels requires multiplying the scaled run values by 20. Table 1 lists various slope percentages, scaled run values, and pixels for a contour scan at 20 RES. The scale is 1:50,000 and the contour interval, 20 meters.

TABLE 1

% SLOPE	Run Values at 1:50,000; Contour Interval = 20 meters	# of Pixels
45%	.88 mm	18
30%	1.33 mm	26
20%	2:00 mm	40
10%	4:00 mm	80
3%	13:33 mm	266

A brief understanding of some of the R250MS editing functions is necessary at this point.

FINDEP	Locates end point and discontinuities of a specified color.
SKELETON	Shaves excess pixels off lineal features leaving lines of one pixel widths.
FRAME	Adds a border of a specified color to any color in the "pattern" (scan file) at the expense of its neighboring color.
PLACE	Superimposes one pattern onto another with color substitution options.

Prior to scanning a contour source, the operator applies a third color (not present on the document) over contour labels, depression ticks,and other unwanted features. China marker on film based sources is sufficient. During calibration, the contours are assigned one color (#1), the background area another color (#2), and the china marker still another (#3). Upon completion of the scan, use of the FINDEP command is necessary. By accessing those areas containing color #3, the operator can, for instance, remove the contour label, delete the flagging color (#3), and connect the contour. Once all contours are continuous, lines are then reduced to one-pixel widths using the SKELETON function. (Figure 1).

With the contours at a width of one pixel (.05 at a 20 RES scan), a series of FRAME operations are performed. Again, to determine whether two contours are close enough to satisfy, let's say, a 45%+ slope, they would be,at most, 18 pixels apart. By "framing" the

contours in the pattern with nine pixels(adding nine pixels to each side of a contour, in the same color as the contour), convergence of any two contours indicates at least 45% slope (Figure 2).

Because one side of a contour may converge with an adjacent contour and the other side not, another FRAME operation is necessary to restore the non-convergent side to its original position. This is performed by framing the background color (#2) with nine pixels of the same color. Areas of convergence on one side of the contour remain (for no background color exists there to frame), while the other side resumes its pre-frame location. This isolates areas whose contours are 18 pixels or less apart in color #1. (Figure #3)

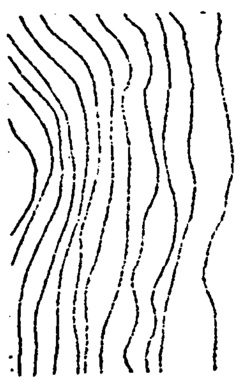
Figure 1

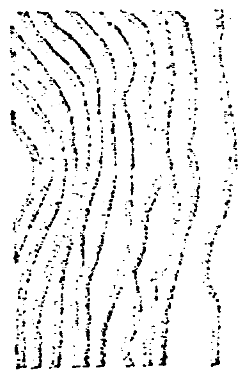
Figure 2

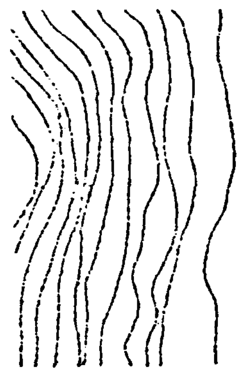
Figure 3

The resultant pattern of 45% slope is stored, and a copy of the original skeleton pattern is again displayed. The preceding series of frame operations is repeated, changing only the number of pixels added to each contour. For a 30%+ slope, 13 pixels are used; 20%+ slope, 20 pixels, etc. (½ the number of pixels in Table 1).

With all slope patterns stored, a series of PLACE operations are performed to isolate areas of equal slope range. In the 3%+ pattern, areas greater than 3% are in color #1, while areas less than 3% are in color #2. In the 10%+ pattern, areas greater than 10% are in color #1, and areas less than 10% are in color #2. By "placing" the 10%+ pattern onto the 3%+ pattern, a range of 3-10% slope can be achieved. Any pixel color #1 (in 10%+) registering itself to another pixel color #1 (in 3%+) is changed to a third color, in this case, #3. This new pattern now contains three colors; #2 = less than 3% slope, #1 = 3-10% slope, and #3 = 10%+ slope. Subsequent placing of the remaining patterns, in the same fashion, produces a final pattern with the following colors and slope ranges (Table 2).

TABLE 2

COLOR	SLOPE RANGE
#2	0-3%
#1	3-10%
#3	10-20%
#4	20-30%
#5	30-45%
#6	45%

Output of this information can vary according to the desired use. Colors representing separate slope ranges can be plotted alone or together with available screening options. Placement of the contours onto

the final pattern in another color is one more possibility.

Isolated hilltops and contours that sharply double back onto themselves tend to converge, introducing some errors. A preliminary plot (preferably on photographic paper) is useful in locating these errors. Standard editing techniques can be performed to change these areas to their proper slope designations.

This automated procedure represents a vast improvement in slope derivation. Preliminary results indicate that this method reduces the time involved for slope collection to at least one-half that of manual techniques. A breakdown of manhours and system times expended during a recent test are provided in Table 3. (Source was at a scale of 1:50,000 with a moderate contour density.)

TABLE 3

	Hours
Calibration and scan	3.0
Findep function	3.5
Skeleton function	1.5
Framing functions	4.5
Placement functions	1.0
Film Positive Plot	.5
Photo Lab Processing	2.0
TOTAL	16.0 Hours

Graphic processing utilizing raster technology is an exciting and dynamic frontier in automated cartography. Not only is the use of such systems revolutionizing production processes, it is also paving the way for the developement of new cartographic products; a substantial challenge facing cartography today.

SOURCES CITED

Gilman, Clarence R., "Photomechanical Experiments in Automated Cartography," in Jour. Research U.S. Geological Survey, Vol. I, No. 2, Mar.-Apr. 1973, pp. 223-227.

Schneier, Jan S., "Chart Revision and Reproduction with the Advanced Raster Cartographic System," in Proceedings of the 20th Annual Canadian Hydrographic Conference, Apr. 1981, pp. 72-77.

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DESCRIPTION OF MATERIAL

AUTOMATED SLOPE - SCI-TEX SYSTEM

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Gerald J. Maier	GERALD J. MAIER, SFC, USA SSO NCOIC

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